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Effect of the Sodium Lauryl Sulphate on the Kinetics of Iodination of Aniline by Iodine

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ABSTRACT

The effect of sodium lauryl sulphate on the kinetics of the Iodination of aniline was investigated by conventional technique. The kinetics was studied in absence and presence of various concentrations of sodium lauryl sulphate at different time intervals at 25.0ºC. The second order kinetics was observed. The result showed that the specific reaction rate of Iodination of aniline markedly enhanced above critical micelle concentration of sodium lauryl sulphate.

Keywords: Sodium lauryl sulphate, Kinetics, Iodination, Aniline, CMC.

INTRODUCTION

Iodination of aromatic compounds have variety of applications in organic synthesis particularly in the synthesis of pharmaceuticals[1-6]. Aromatic iodides have been used in the synthesis of natural products[7], bioactive materials[8], medicinal[9] and pharmaceutical research[10]. Iodination of aromatic compounds are known to be subjects of many workers[11-15]. Therefore in present study we have carried out the iodination of aniline by iodine. Further, the effect of sodium lauryl sulphate on the kinetics of the iodination has been investigated.

EXPERIMENTAL

All chemicals used for preparation of stock solutions were of analytical grade. Doubly distilled water was used for the preparation of solutions and dilution. Aniline solutions were freshly prepared just before the experiment and aniline was stored under nitrogen in amber coloured bottle.

KINETICS

Iodine in sodium iodide was used as iodinating agent. The rate of iodination of aniline by an aqueous solution of iodine in sodium iodide was determined with 250 cm^3

of solution containing 5.0 x 10^{-3} M aniline and 5.0 x 10^{-3} iodine in 5.0 x 10^{-2} M sodium iodide. The rate of reaction was studied at 25.0ºc. The unreacted iodine was estimated by titrating 25.0 cm^3 of aliquots of the reaction mixture against standardized 2.5 x 10^{-2} M sodium thiosulphate at intervals of time using freshly prepared starch as an indicator. The rate of reaction was also determined in various concentrations of sodium lauryl sulphate.

RESULTS AND DISCUSSION

The kinetic studies were performed in the absence of sodium lauryl sulphate and the concentration of the unreacted iodine were determined for the reaction mixture containing equal concentration of iodine and aniline (5.0 x 10^{-3} M). The graph plotted between $1/[I_2]$ and time (t) has been shown in Fig.1. The second order rate constant evaluated from this graph is 2.6 x 10^{-2} M^{-1} S^{-1}.

In the further stages of the study, the effect of micellar media on the rate of reaction was investigated. For this purpose, critical micelle concentration (CMC) of sodium lauryl sulphate was determined in the presence of 5.0 x 10^{-3} M aniline and iodine. The CMC of sodium lauryl sulphate in these reagents was found to be 6.0 x 10^{-4} M from the inspection of absorption sodium lauryl sulphate concentration graph.

The $1/[I_2]$ versus time graph (Fig.2) was plotted with the observed $[I_2]$ values during the reaction of 5.0 x 10-3 M aniline and iodine solutions in the presence of sodium lauryl sulphate in different concentrations in order to see its effect in second order iodination of aniline.

The nature of graph in Fig. 1 is a straight line indicates a second order reaction in the presence of equally concentrated reactants.

The observed lower CMC value of sodium lauryl sulphate in the presence of aniline and iodine (6.0 x 10-4 M) than that in pure water (5.0 x 10-3 M) indicates the interaction between sodium lauryl sulphate and the reactants which results in the solubilization of reactant in the micellar pseudophase. This shows that aniline is concentrated at the micellar interface and iodine is solubilized in the micellar interior in amounts according to the equilibrium of iodine in micelle and aqueous phase. The equilibrium constant of which depends on the concentration of the sodium lauryl sulphate.

From Fig.1, it can be concluded that the reaction is catalysed by sodium lauryl sulphate. The increase in rate is observed on micelle formation and with increasing the micelle concentration. This rate enhancement is also confirmed by Fig.2 which illustrates the effects of sodium lauryl sulphate monomers and submicellar aggregates on the reaction rate. This supports the fact that monomers and submicellar aggregates affects the rates in the same manner as their micelle. The Fig. 1 and Fig.2 lead us to conclude that Iodination of aniline is catalyzed by sodium lauryl sulphate.

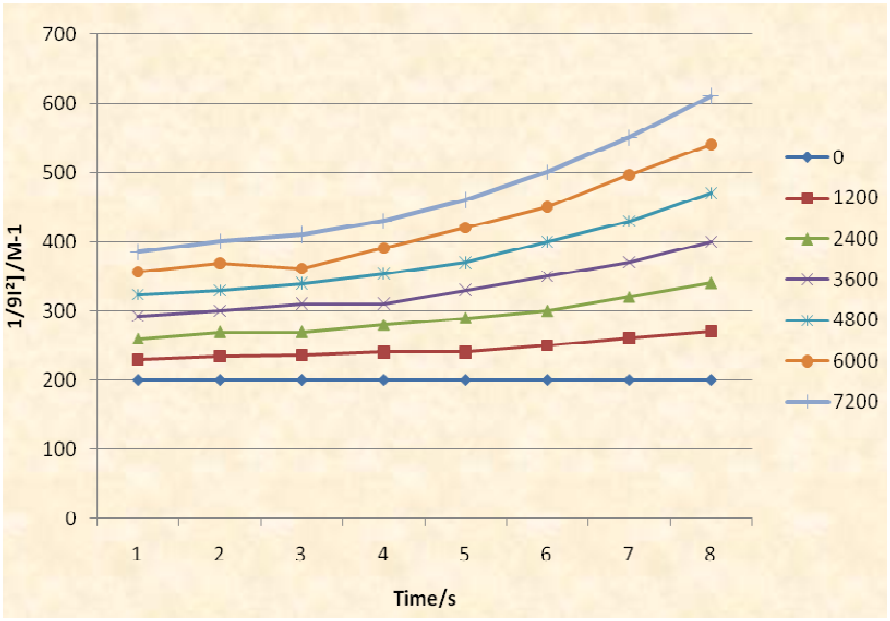

Fig.1 : Dependence of reaction rate on different concentrations of sodium lauryl sulphate

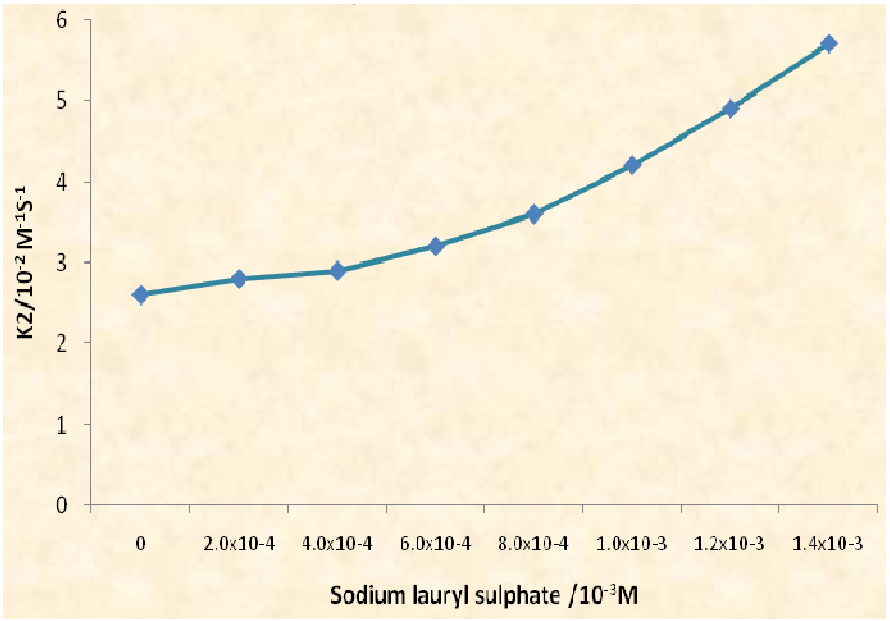

Fig.2 : Variation of specific reaction rate with sodium lauryl sulphate concentration

REFERENCES

1. A. Bachi, F. Foubelo and M. Yus, *Tetrahedron*, 50, 5139 (1994).
2. G. A. Olah, Q. Wang, G. Sanford and G. K. S. Prakash, *J. Org. Chem*., 58, 3194 (1993).
3. R. C. Larock and E. K. Yum, *J. Am. Chem. Soc*., 113, 6689 (1991).
4. R. C. Larock and N. H. Lee, *J. Org. Chem*., 56, 6253 (1991).
5. E. C. Taylor and G. S. K. Wong, *J.*. *Org. Chem*., 54, 3618 (1989).
6. W. C. Ekelman, H. R. Adams and C. H. Paik, *Int. J. Nucl. Med. Biol*., 11, 163 (1984).
7. C. A. Bussaca and R. E. Johnson, *Tetrahedron Lett*., 33, 165 (1992).
8. J. S. Swenton, A. Callinan and S. J. Wang, *J. Org. Chem*; 57, 78 (1992).
9. N. D. Hendel, H. D. Burns, T. Honds and L. W. Brandey, *Chemistry of Radiopharmaceuticals; Eds. Masson*; New York, 1997.
10. B. S. Painter and F. G. Soper, *J. Chem. Soc*., 342 (1947).
11. E. Berliner, *J. Am. Chem. Soc*., 73, 4307 (1951).
12. G. V. Shashidhar, N. Satyanarayana and E. V. Sundaram, *Ind. J. Chem*., 25, 289 (1986).
13. P. S. Radhakrishnamurthy and R. Janardhana, *Indian J. Chem., 19 A*, 333 (1980).
14. H. Firouzabadi, N. Iranpoor, M. Siri, *Tetrahedran Lett*., 44,8781 (2003).
15. A. S. Castanet, F. colobert and P. E. Broutio, *Tetrahedron Lett*. 43, 5047 (2002).
16. G. W. Kabalka and A. R. Mereddy, *Tetrahedron Lett*; 45, 343 (2004).
17. K. V. V. Krishna Mohan, N. Narendre, S. J. Kulkarni, *Tetrahedron Lett*; 45, 8015 (2004).